CLAIMS

We claim:

1. A chemical reactor for a catalytic chemical reaction with at least one gas phase reactant, said chemical reactor, comprising:

(a) at least one reactor microchannel of at least one wall defining a bulk flow path through which said at least one gas phase reactant passes, and at least one product;

(b) a catalyst structure wherein said at least one gas phase reactant contacts said catalyst structure and reacts to form said at least one product, wherein said catalyst structure has;

(c) a porous material having a first porosity that permits molecular diffusion therein, said porous material further having a length, a width and a thickness, and a porosity surface area, said porous material defining at least a portion of said at least one wall of said at least one reactor microchannel; wherein

said at least one reactant entering said at least one reactor microchannel in said bulk flow path, flowing past and in contact with said porous material, a portion of said at least one reactant molecularly diffusing transversely into said porous material and reacting therein wherefrom said at least one product molecularly diffuses transversely into said bulk flow path thereby transporting said at least one product from said reactor.

2. The chemical reactor as recited in claim 1, wherein at least 20% of a circumference of said bulk flow path is defined by said porous material.

3. The chemical reactor as recited in claim 2, wherein at least 50% of said circumference of said bulk flow path is defined by said porous material.

B1479_app
08/17/99

4. The chemical reactor as recited in claim 1, further comprising at least one heat transfer microchannel adjacent said reactor microchannel.

5. The chemical reactor as recited in claim 1, wherein said porous material is a catalytic material.

6. The chemical reactor as recited in claim 1, wherein said catalyst structure comprises said porous material as a non-catalytic material with a catalytic material on said porosity surface area.

7. The reactor as recited in claim 1, wherein said catalyst structure comprises a second porous material having a second porosity on said porosity surface area, said second porosity permitting Knudsen diffusion, said catalyst material on said second porous material.

8. The reactor as recited in claim 1, wherein said catalyst structure is an insert.

9. The reactor as recited in claim 8, wherein said insert is removable.

10. A method for a catalytic chemical reaction with at least one gas phase reactant, said method having the steps of flowing said at least one gas phase reactant past a catalyst material and reacting said at least one gas phase reactant to form at least one product; wherein the improvement comprises:

(a) providing said catalyst material as a porous structure having a porosity that permits molecular diffusion therein, said porous structure further having a length, a width and a thickness, said porous structure defining at least a portion of at least one wall of a microchannel defining a bulk flow path through which said at least one reactant passes;

(b) flowing said at least one reactant through said microchannel, past and in contact with said porous structure containing said catalyst material, a portion of said at least one reactant molecularly diffusing transversely into said porous structure and reacting therein wherefrom said at least one product molecularly diffuses transversely into said bulk flow path thereby transporting said at least one product from said reactor.

11. The method as recited in claim 10, wherein said catalytic reaction is selected from the group consisting of steam reforming, CO_2 reforming partial oxidation, chlorination, fluorination, hydrogenation, dehydrogenation, nitration, water gas shift, reverse water gas shift, autothermal reforming, combustion, hydrocracking and hydrodesulferization.

12. The method as recited in claim 10, wherein a gas hourly space velocity is greater than 10,000 corresponding to a residence time less than 1 second.

13. The method as recited in claim 10, further comprising at least one heat transfer microchannel adjacent said reactor microchannel.